GAS IN INDUSTRY

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FEATURES

HEAT TREATMENT IN VESPA MOTOR SCOOTER PRODUCTION

THE MANUFACTURE OF POTATO CRISPS
By Eric Ford

NEW DEVELOPMENT IN GRILLS, SALAMANDERS AND TOASTERS
By 'GAStronome'

FURNACE PLANT AT THE BABCOCK & WILCOX LTD. FACTORIES

NEW STAFF KITCHEN FOR SIEMENS EDISON SWAN AT HARLOW

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Editorial

The Factory Canteen

THE canteen has now become a recognised part of industrial and commercial life. All factories above a certain size have their own canteen facilities for their employees and the number of offices providing similar facilities is fast increasing.

The importance to the industrialist of canteen equipment is therefore becoming much greater and the problems facing a factory manager about to embark on a new canteen or the extension of an existing one, can be easily solved by reviewing the available gas-fired equipment. Such equipment covers every branch of cooking, including the making of tea and coffee.

The realisation of the need of providing meals for the factory worker came as the result of rationing during the war. With the setting up of the low cost restaurant in which wholesome food could be made available for anyone whatever his income group, the eating habits of the factory worker changed; no longer was the packet of sandwiches sufficient and something more than a means of boiling a kettle had to be provided. The factory canteen has become a necessity, but at the same time a careful watch must be kept on the menu; its variety must not be forgotten, nor must the standard of cooking be allowed to deteriorate.

It is with such thoughts in mind that we are publishing the present series 'Know Your Kitchen Equipment,' by 'GAStronome.' This particular contributor is well known to readers of 'GAS IN INDUSTRY' for his forthright comments on the problems facing the canteen manager behind the scenes. He has shown that the hard work associated with cooking suitable meals for large numbers can be greatly lightened by the provision of the right type of appliance, with which is included a properly laid-out kitchen equipped with adequate hot water and the most modern means of washing up.

In each of the articles in the series—we are publishing the fourth this month—'GAStronome' has concentrated on some particular aspect of the canteen kitchen, stressing in each case how proper design and layout, coupled with modern, high efficiency gas-fired equipment, not only eases the work of the staff, but facilitates an organised schedule.

The provision of meals over a two-hour period in the middle of the day means that during that time the activities of the serving staff are at their greatest, the cooks having made their contribution earlier. If the customer is to be served as he should be, any time saved in the cooking can be used for the better preparation of the food, a higher standard of cleanliness in the kitchen and a general sense of efficiency of the staff.

As 'GAStronome' pointed out in the first article of the series, all competent industrialists know the right type of machinery to install on the factory floor and the fate of all inefficient, old-fashioned equipment, but perhaps they do not all know that the same applies to catering. Modern industrial catering equipment must not be confused with its domestic counterpart nor must it be compared with the old-fashioned solid fuel range. Modern gas-fired catering equipment is designed for a specific object—turning out well cooked food for large numbers—and for that purpose it is pre-eminent.

VESPA SCOOTER ASSEMBLY LINE PRODUCTION NEEDS CLOSE HEAT TREATMENT SCHEDULES

FOR some time since the war the market in motor 'scooters' has been dominated by machines made on the Continent—particularly Italy, home of the scooter.

The Douglas Company of Bristol, already famous in the motor-cycle field, decided at a very early date that the scooter would in time prove a valuable asset as a means of cheap, independent travel in this country, and as a result the Vespa was introduced to England by Douglas in 1951. Since that date Douglas, through their Vespa organisation, have sold approximately 100,000 of these world-famous scooters. A considerable number of these have been sold to public bodies, including the police, gas boards, water boards, electricity boards and fire services.

Latest methods

These machines are produced at Bristol under licence from Piaggio of Italy, in a modern factory using all the latest assembly-line methods common to the motor car industry.

Construction of the components for the power, transmission and braking systems present many problems for the metallurgist. Most of them depend upon heat treatment, which demands very close time/temperature schedules. For this reason most of the furnaces are on automatic temperature control where thermocouples measure the temperature and transmit an electrical signal to control pyrometers which operate valves in the gas supply according to the measured temperature. This ensures that the temperature never varies from the close limits necessary for the correct heat treatment which largely determines the life of these parts.

Cheap costing

The Douglas Company uses town gas supplied by the South Western Gas Board for melting, hardening, tempering, and carburising, as well as stoving the synthetic paint finishes. For these purposes town gas is the most suitable fuel because its declared calorific value is a significant factor in precise automatic control. Other advantages are that there are no interruptions for fuel deliveries, and that the gas meter provides the simplest and cheapest form of fluid fuel costing.

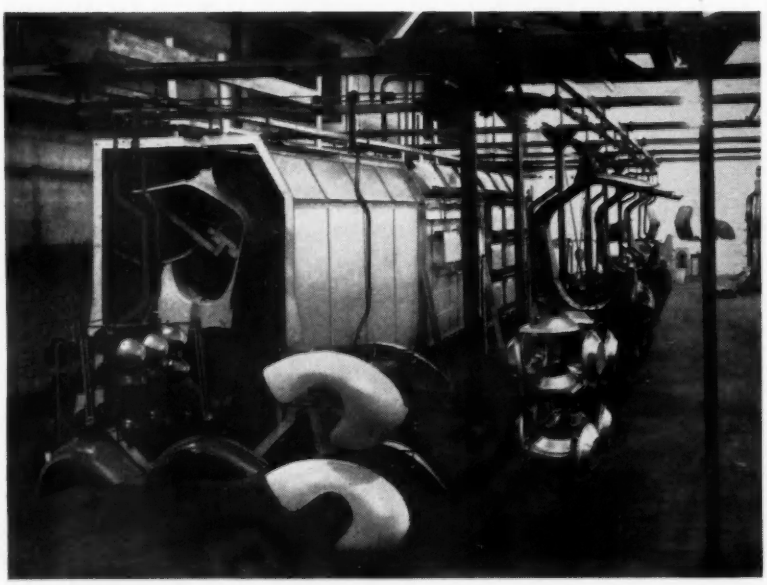
In the foundry, gas is used for core drying, and aluminium alloy melting is carried out in three gas-fired melting furnaces, the molten metal being used for the gravity die-casting of the light alloy components. Crank-shafts, gears, and similar parts require special heat treatment, and in the carburising shop there are three gas-fired muffle furnaces as well as a high-speed tempering furnace. Other non-ferrous components are treated in gas-fired salt bath furnaces.

The chassis, mudguards and other parts, after assembly, stress-relieving, and filling, pass on conveyors into the finishing shop. After being sprayed with a number of priming and finishing coats of paint, the components pass—still on conveyors—into a gas-fired, infra-red paint stoving oven which was specially designed to suit the awkward shape of the chassis. Again, town gas was chosen as the fuel because it lends itself more easily to the close time/temperature schedules required to cure the modern synthetic paints.

Industrial showroom

As part of its service to industrialists in its area, the South Western Gas Board has recently opened an industrial gas showroom where factory executives can inspect working examples of infra-red tunnels, natural draught oven furnaces, recirculating ovens, and other equipment. Anyone can bring along the components in which they are interested and try them out with the equipment in advance of purchase.

In addition, there is a wide range of gas burners together with ancillary equipment such as flame protection and ignition systems where automatic temperature control figures prominently.



Gas-fired paint stoving ovens for Vespa parts, including chassis, lamp housings, steering columns with mudguards, engine wings and fan cowlings, installed at Douglas Engineering (Kingswood) Ltd.

New Incandescent group office

THE Incandescent group of companies, which includes the Incandescent Heat Co. Ltd., Metalectric Furnaces Ltd., Controlled Heat & Air Ltd., and Selas Gas & Engineering Ltd. has for many years supplied thermal engineering equipment to the major industries of South Wales.

In the light of the present and future industrial importance of this area, the Incandescent group has opened an area office at 40, Newport Road, Cardiff (Tel.: Cardiff 37715) under the management of Mr. J. W. Payne.

The socially-ubiquitous potato crisp

AND HOW GAS-FIRED EQUIPMENT ENSURES HIGH QUALITY

A micrometer is used periodically to check the thickness of the potato slices before they are cooked. If these slices are too thick or too thin, the quality of the final product will be affected.

By Eric Ford

IN recent times, the ubiquitous potato crisp has rapidly advanced in the favour of all classes of society so that today it is just as likely to grace the tables at a Park Lane reception as to be found in the hands of a small boy watching a football match. To maintain the patronage of such a varied clientele, the manufacturers pay the closest attention to the preparation, cooking and packaging of their popular product.

Cooking plants

Accordingly, it will come as no surprise to those who are already aware of the qualities of gas in cooking applications to learn that gas-fired cooking plants are widely favoured by potato crisp makers for turning out a product which shall be both attractive in appearance and appetising in taste.

This is certainly the case at the works of Crimpy Crisps Ltd., Winnersh, near Wokingham, Berkshire, where gas is supplied by the Southern Gas Board through a No. 60 BM meter rated at 20,000 cu.ft. per hour. The current increasing demand for the company's products is likely to result in an even higher gas load in the future.

It was in August, 1950, that potato crisp production commenced at the Winnersh plant, which is pleasantly situated on a four-acre site in the vicinity of Reading. The factory buildings cover some 70,000 sq.ft. and, with their fresh colour scheme, give an immediate impression of that hygienic approach which one instinctively expects from a factory producing a food product. This impression is fully maintained inside the light and airy buildings, which provide employment for a work-force of about 150, of which about 25% are women and girls.

Gas finds its main application at the Crimpy Crisp factory in the actual cooking of the crisps, but although the cooking plants can be regarded as the very heart of the process, the production of potato crisps commences long before that stage is reached. In fact, the story can be traced back to the Lincolnshire fields, where 'Record' potatoes are grown by the acre for the exclusive use of Crimpy Crisps Ltd.

Potato storage

Although potatoes are harvested only during a comparatively short period of the summer and autumn, the crisp manufacturer requires an even flow of supplies throughout the whole year. Potatoes, therefore, have to be stored at some point, and this duty is now shared between farms supplying the firm and itself. The bulk of the supply is stored in special accommodation in Lincolnshire where the potatoes are kept at temperatures between 45°F. and 50°F.; steps are taken to inhibit premature sprouting.

Supplies are released as required, being transported to Winnersh in insulated vans. This in itself is a considerable undertaking for the factory consumes thousands of tons of potatoes a year.

Air heater

About a week's supply of potatoes is kept at the factory. These are stored in a special store room, fitted with slatted hoppers through which air can circulate. All windows can be blacked-out to prevent the potatoes sprouting and therefore shrinking. In winter, the room is heated to a temperature which varies between 45°F. and 75°F., depending on the sugar content of the potatoes in store.

This room is located on the upper floor of the building and heating is provided by a Harris gas-fired air heater, with a capacity of 100,000 B.t.u. per hour. The heater is suspended from the roof trusses and, in addition to the integral fan incor-

porated in the unit, the circulation of air throughout the storage room is completed by two additional electrically-driven fans fitted with ducting. Temperature is automatically controlled by electric room stat. About 100 tons of potatoes can be stored here.

Each consignment of potatoes is subjected to tests on arrival to determine specific gravity and sugar content, since this information, together with the results of a cooking test, determines the optimum processing conditions for that particular batch, especially in its course through the cookers.

Preparatory stages

Much has to be done, however, before the cooking stage. Potatoes from the store pass through a number of preparatory stages, almost all of which are automatic, thanks to the ingenious use of conveyors of various kinds. Briefly, potatoes are placed in a hopper, moving thence to a rotary tumbler by means of a suitable elevator. The function of the tumbler is to remove any dirt and foreign matter, through the action of the water which is continuously sprayed through slots in the drum. Incidentally, as much water as possible is reclaimed and used again, since so much is required.

Potatoes emerge from the rotary tumbler into a brine tank, the salt content of which is so adjusted that the potatoes float, permitting any stones to fall to the bottom. This precaution is said to be necessary at the height of the potato lifting season when temporary labour engaged at high speed in potato gathering can easily mistake a stone for a dirt-covered potato.

From the brine tank, another elevator conveys the potatoes to a Mather & Platt Ltd. automatic peeling machine comprising a series of rotating carborundum rollers. A bucket elevator next takes the peeled potatoes to the slicing machine. Before they reach the slicer, however, the potatoes are inspected and any unsuitable material is thrown out.

Until this point, the potatoes have been passing along a single production line, but the overhead conveyor belt feeding the washed potatoes is divided by means of an adjustable plough which governs the amount of potatoes fed to the two automatic cooking machines.

In the next stage of the production line, the washed and peeled potatoes move to the slicing machines in which the tubers are pressed against rotating metal plates fitted with knives.

Slices pass along a wire mesh conveyor to a rotary tumbler for a further washing, which removes surface starch. Any surplus starch remaining on the slices when they enter the cooker would prove injurious to the oil in which they are cooked. This also explains why the firm is able to claim that their product is 'starch-reduced'—an important selling point to those with waistline troubles!

This washing also removes any small pieces of potato, thus ensuring that only large slices go forward to the cookers. A final washing and rinsing operation follows, after which the slices are ready for cooking.

At this stage, the slices should, generally speaking, range in thickness from about 50 to 70 thou., depending on the type of potato and, in fact, regular checks are made, using a micrometer, to ensure that these tolerances are not exceeded.

Two machines

Two automatic continuous cooking plants are sited parallel to one another in the spacious, well-lit main building. The older of the two machines has been in operation for about eight years, during which time it has given every satisfaction. The new machine was installed only a few months ago.

Both cookers operate on basically the same system. The sliced potatoes arrive at the mouth of the cooker on

One of the problems facing any food manufacturer is the cleaning of returned empty tins, where this form of outer packing is employed. Crimpy Crisps Ltd. solve this difficulty with a gas-fired tin washing and drying plant.

Of the two cookers shown here, the one on the right has only been installed a few months while the other has been in successful operation for about eight years. Both have been designed by Crimpy Crisps Ltd., in co-operation with the Southern Gas Board, and manufactured in the firm's own workshops.

a conveyor and drop off the conveyor into a bath of edible oil which runs the length of the machine. Groundnut oil is employed exclusively for this purpose.

This oil circulates steadily along the length of the bath which, on both cookers, is 20 ft. long and 4 ft. wide. The recirculating pump, which is of the centrifugal type, was manufactured and supplied by Sigmund Pumps Ltd., Gateshead.

Cooking oil is recirculated through a series of mild steel tubes in the combustion chamber below the bath. There are about 60 of these tubes, which are shaped in the form of a narrow U and run transversely across the chamber, each tube being set in the vertical plane, with ends welded into a vertical header tank built into the brickwork on one side of the combustion chamber.

Gas consumption

On both cookers the burners are situated at the entry end, the gas consumption of each machine being of the order of 10,000 cu. ft. per hour. The older cooker is fired by four Thermic air blast burners with the supply to each controlled by a 1½-in. main cock. Air for combustion is supplied by a Keith Blackman fan at 20 in. w.g. The new cooker is fired by two Shieldrop dual-fuel burners, each having a capacity of 30 therms per hour.

Automatic temperature control on the older cooker is effected by Negretti & Zamba and by Cambridge control equipment on the newer cooker. Both plants are safeguarded by Radiovisor flame failure controls.

Operating methods are similar on both cookers. The circulation of the edible oil causes the slices to move along the bath towards the exit end. A series of rakes attached to gently rotating arms continuously push the slices under the oil, to ensure that they are cooked evenly right through and on both sides.

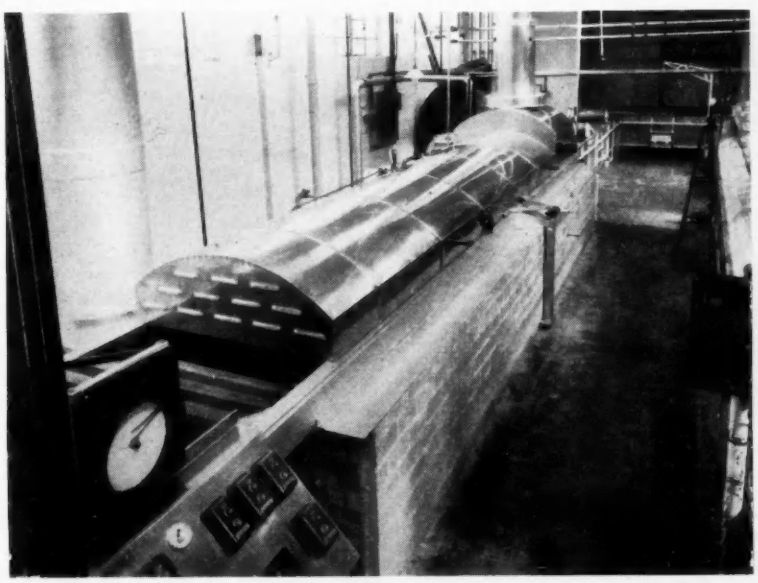
Obviously, an important point is to maintain the bath of edible oil at the correct temperature, which, incidentally, will vary with the type of potato and the time of year. Generally speaking, the crisps will take longer to cook in the winter than when new potatoes are being processed. The tests which are taken on each consignment of potatoes on arrival at the factory naturally play an important part in deciding the appropriate operating temperatures.

These tests are the responsibility of the firm's control laboratory which also exercises overall supervision of the quality of the product at all stages of manufacture.

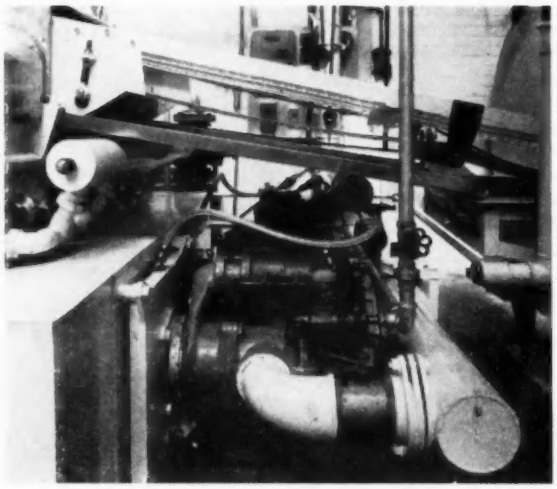
Expertise

Cooking temperatures will generally average around 350°F. and it is perhaps comforting to note that despite the scientific approach which the company wisely employs in determining operating conditions at the cookers, the accumulated expertise of the cook-in-charge is still necessary in making final adjustments to ensure a really high quality product. It was noted, for example, that the time-honoured method of tasting the product as it comes fresh from the cooker was not despised!

A supply of edible oil is kept in a 5,000 gal. tank, which is connected by pipe-lines to the two cookers. The bath in the older machine holds 450 gal. and that in the new cooker 250 gal. A considerable amount of oil is used up in cooking the crisps and the supply is automatically re-



Crimpy Crisps' new cooker seen from the exit end. Note the ideal position of the recorder/controller and control panel from which vantage point the operator can observe the entire production line.



Flame failure equipment in the new cooker is of the photo-electric type and one of the electric 'eyes' can be seen mounted on the burner plate at the base of the burner.

plenished while, at the end of a production period, the unused oil can be drawn off and stored in a special 1,000-gal. tank to be used again.

Having thus briefly outlined the basic similarities in the construction and operation of the two cooking machines, it will now be appropriate to refer in greater detail to the newer of the two installations, for this is a particularly interesting and noteworthy piece of equipment.

This new cooker (and, indeed, the older model also) was constructed in the company's own extensive and well-equipped workshops, which not only produce the cooking equipment but undertake a great deal of other work, such as the adaptation, repair and maintenance of the fleet of specially-adapted vehicles which distribute the finished product.

The method of firing the cooker, the design and construction of the combustion chamber, burners and flame failure equipment and associated items were developed in conjunction with the Industrial Department of the Southern Gas Board. The entire construction, installation and commissioning of the plant was carried through by the engineering staff of Crimpy Crisps Ltd. The older cooking plant was designed and constructed in conjunction with the industrial staff at Watson House laboratories, London.

Two burners are fitted to the new cooker; they fire horizontally into the combustion chamber. These burners are of special interest in that they can be fired either by gas or oil, or any combination of both fuels. For this reason, separate supply lines are fitted for the supply of gas and fuel oil respectively. So far, however, the cooker has been operating mainly on gas.

One of the advantages of the new equipment over the old is that it can be brought into operation more quickly. This is important because it is the practice of the firm to draw off the edible oil at the close of each day, so that the equipment can be thoroughly cleaned and a fresh start made on the following morning.

Despite the large amount of oil required in the bath for cooking purposes, the time taken to raise this oil up to the required cooking temperature is no more than 30-35 minutes from cold. The heating-up process is gradual, in order to avoid local overheating.

Control panel

All the controls for the cooker are sited on a well-designed control panel near the exit end of the machine, from which point the operator has a clear view of the entire process. The controls include push-button operation of all the mechanisms related to the actual working of the cooker, such as the conveyor belt, slicer and the like.

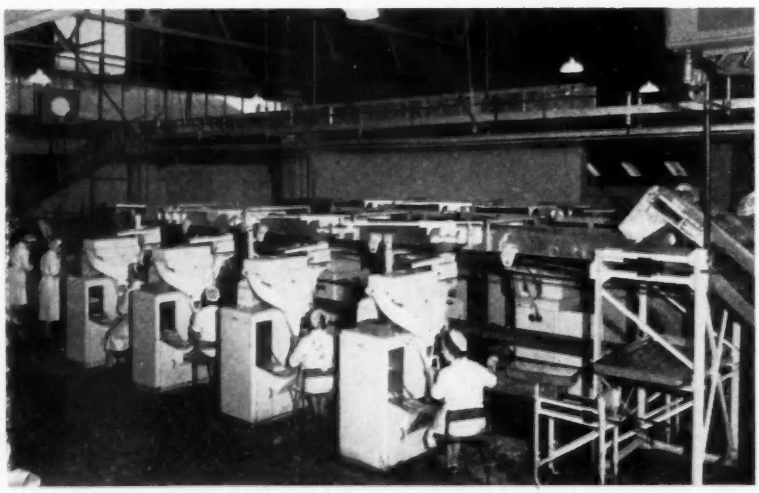
Starting up procedure is clear and straight-forward. Oil is first run into the bath and the level checked. The burners are then started up. When the edible oil is up to the required temperature, as determined by the laboratory tests of the sugar content of the consignment of potatoes to be cooked, the switches controlling the operation of the production line can be switched on.

A recorder/controller is also incorporated into the panel. This records and controls the temperature of the oil in the bath and maintains the heat at the required level, irrespective of the number of crisps being processed. The thermocouple type of thermometer now employed provides the necessary sensitive response.

Warning equipment

Flame failure equipment, by Radiovisor Ltd., incorporates a magnetic valve and is linked to a warning system on the control panel which shows a continual green light when the gas supply is flowing normally and emits a red warning light should flame failure occur.

Another important feature of this cooker is an economiser, so that what would otherwise be waste heat is em-



Untouched by human hand! In the packing department, crisps move along the overhead conveyor and fall down through the automatic weighing machines into bags beneath the chutes. Not forgetting to insert the little blue bag of salt, the packer places the bag on another conveyor (see girl's right hand at bottom right) for transfer to the other end of the line where other operators direct the bags through automatic sealing machines.

ployed to pre-heat the incoming cooking oil. This gives the new cooker a significant economic advantage over the older equipment.

A number of electric motors, mainly fractionals and in the small horsepower range, are used to power the various conveyor systems and pumps. Most of these motors have been manufactured and supplied by Newman Industries Ltd. of Yate, Bristol, who specialise in the production of motors for these applications.

On all counts, this cooker must be acclaimed an outstanding piece of equipment, the credit for which must be shared between the engineering department of Crimpy Crisps Ltd., and the local industrial gas engineer. Particular credit must be given to Mr. D. A. Sword, Managing Director of the Winnersh plant and son of the Chairman of the company, Mr. J. C. Sword. Mr. D. A. Sword has spent some considerable time in the United States, where he has studied methods of crisp manufacture. As a result, the Winnersh plant is undoubtedly one of the most up-to-date and highly mechanised on this side of the Atlantic.

Airdrie factory

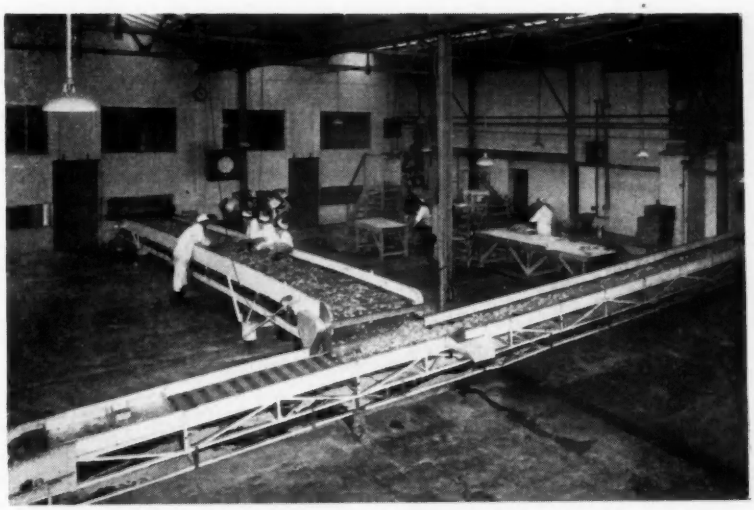
An essentially similar plant to this is installed in the company's other manufacturing plant at Airdrie, Lanarkshire, which was started in 1937 and is, in fact, the present headquarters of the firm. A large amount of gas is consumed here also. All the machinery for both factories is made in the Winnersh engineering shops.

So successful has this cooker been that Crimpy Crisps Ltd. have now entered the cooker manufacturing field and one large fully-automatic cooker has already been exported to Denmark. This must not be taken as meaning, however, that the firm plans to intend devoting increasing attention to this unusual but promising side of its business.

'After all, we are potato crisp manufacturers,' says Mr. D. A. Sword. 'That is our business and we must not neglect that in favour of engineering.'

Nevertheless, provided the existing workshop capacity is able to deal with any orders which may come along, there seems every likelihood that Crimpy Crisps Ltd. will continue to supply models of this cooker.

Up till the time they enter the cooker, the product is described as a 'slice,' but when, after a cooking period of from 1½ to 3½ minutes, it emerges from the other end, it has become a 'crisp,' in all its golden-brown glory. Crisps by the thousand move out of the cooker on the conveyor, for the new cooker has a planned capacity of about 850 lb. of crisps an hour.



The finished crisps leave the cook-house and proceed on conveyors to the packing department.

As they move from the cooker towards the packing department, the crisps are air-cooled and inspected for any defects. A number of different packs are used, including the family-size pack, tins, and, of course, the familiar cellophane bag.

These are filled at a battery of Hy-Tra-Lec filling machines mounted alongside an overhead conveyor which brings the crisps direct from the cook-house on a series of cooling conveyors. All the operator has to do is hold the empty, open bag beneath a chute down which a weighed quantity of crisps drops. The well-known pinch of salt in its blue waxed paper is dropped in with the crisps and the bag is placed on a conveyor to a Rotoplex sealing machine.

In addition to crisps, the company also produces a number of other products, including roasted nuts, a savoury crisp known as Bar-B-Q and a biscuit and cheese sandwich.

Nut roasting

Gas is used in the manufacture of the roasted nuts. These are first dry-roasted for about an hour in a gas-fired roaster, after which the husks are removed. The next stage is for the hulled nuts to be cooked in oil in a conventional refractory-lined cooking pan, heated by gas and air blast burners.

For the bulk despatch of packets of crisps to wholesalers and retailers, it

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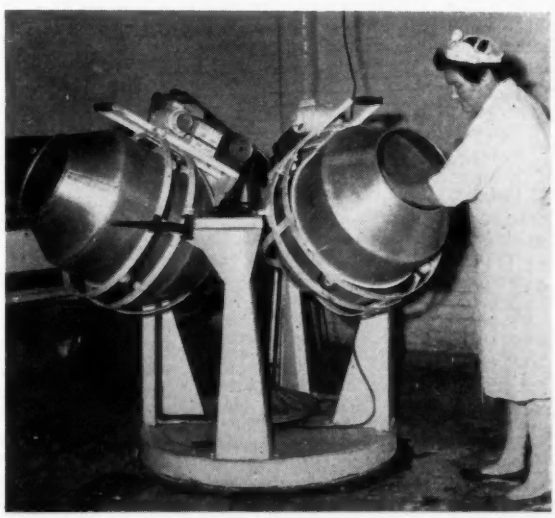

Crimpy Crisps produce other food products in addition to their main speciality. In these rotating drums, a savoury crisp, known as 'Bar-B-Q' is produced.

KNOW YOUR KITCHEN EQUIPMENT

4.—Grills, salamanders, and toasters

By 'GAStronome'

THE canteen kitchen which does not boast the very important appliances used for grilling and salamandering really ought to be corrected without delay. A menu which does not include grilled food or dishes finished with the aid of the fierce heat of these appliances can be very dull indeed. In fact, the grill or salamander as we have come to know this appliance is essential in every kitchen whether large or small.

Cooking merits

On the other hand where such equipment is installed the results obtained may be indifferent—because of the years of service it has given—and the cost of gas consumption quite out of proportion to the results. Either way it is well to consider the cooking merits of the appliances now available, the capital cost involved and the consumption of fuel to be expected.

Gas is particularly suitable for the heating of grills, salamanders and toasters; in fact, no other fuel can achieve the same results.

This is perhaps the point at which to define the terms 'grill' and 'salamander.' The difference always bewilders people. In the true culinary trade the grill has its heated bed *below* a grid-iron upon which the food is grilled, but an appliance that has the heat *above* it is referred to as a salamander.

Toasters

'Toasters' are so named when the appliance has the heat above or at the sides. It will toast bread quickly but is of no practical use for any other purpose.

There are variations of these definitions, such as 'heat applied directly above and indirectly from below.' An appliance so designed could accept either term—and perhaps get away with it.

There are few 'true' grills on the market, but what we have are paramount in their class. Foremost, to my mind, is the Benham under-fired gas grill. This first appeared in the 1930's and has since been redesigned, being a popular choice in many kitchens today. It is capable of grilling up to 24 steaks at a time and its speed ensures the quick service so essential in industrial catering.

A similar appliance is produced by Smith & Wellstood, manufacturers of the well known Esse equipment.

Limited speed

The flat-based grill of Briffault manufacture serves the caterer well, but has limited accommodation and speed. Where it is sufficient for requirements, however, its qualities make it a first-class appliance.

The purists who claim that under-firing of grills is the only proper method of cooking meats will be delighted with one or two other appliances that will soon be placed on the market. When these do appear they should be given very close examination and consideration by managements.

Now we come to the salamander which, as previously stated, has the heat from above. This will of course grill food with the same fierce heat as the under-fired grill, and it has the added advantage that it can be used for browning foods that have been cooked by other means.

There are many of these salamanders on the market and recent developments have re-introduced an old friend, the bottom cooking plate, grilling hearth or brander. This is a solid plate upon which food is placed and which is heated by the burners above. The heat thus not only cooks the food but is absorbed by the bottom plate, which in turn cooks the underside of the meat.

This 'double-cooking' halves the time necessary and almost halves fuel consumption. There is nothing really new about this method; Radiation have used it for many years with their famous solid brander. It has been re-introduced in a modified form by Radiant Heating with their Grillmaster, by R. & A. Main with their 225 and 222 models, and by De La Rue on their light duty catering cooker. There is no reason why this plate should not be used for conventional grills or salamanders. It could be developed as a fixed part of the base of the appliance, and made of highly-polished steel.

Vertically held

There are salamanders on the market that can be adjusted to grills with the heat on either side of the steak or chops, which are held vertically in a wire clamp. The burners are of the surface combustion type, being particularly suitable for grilling work Any fat that falls upon the service is immediately fired and dispersed.

The application of vertical grilling is limited perhaps to the specialist restaurant, but its use in industrial catering should be considered when only a few grills are required. The main asset of the appliance is its general use as a salamander with the burner plates in the overhead horizontal position.

Toasting equipment is either the 'squashed' version of the salamander or mobile racks passed over a heated radiant surface. Radiant Heating's King toaster is one such appliance; others are marketed by American manufacturers and are normally obtainable from catering equipment factors.

All appliances offer a wide potential for any grilling, salamandering or toasting work, and they should be correctly specified accordingly.

A knowledge of the capacity of grilling and salamandering equipment and of the food itself is useful.

Steak definition

Steaks are of a variety of cuts from the quarter of beef and are named according to the cut. Se we have:—

Sirloin steaks (*entrecote*): These are of 1½-in. thickness (Porterhouse steak), of 1-in. thickness (double sirloin steak), and of ½-in. thickness before being flattened (minute steak). To grill these would take ten, five and two minutes respectively on any of the equipment mentioned.

Tournedos: A tournedo is cut from a fillet of beef, round in shape, of 1½-in. or 2-in. thickness. The latter is sometimes called a chateaubriande. These are the best of all steak cuts and grilling times of ten to 15 minutes are recommended. To a caterer of experience the 'tenderising' of any of these steaks by mechanical means is

not necessary. Correct preparation in the traditional manner is all that is required.

Chops and cutlets: These are put on as grills fairly extensively, the cutlets usually being served in pairs—the thickest cutlets, usually double the normal size, called noisettes. Chump chops or loin chops are usually grilled, the cooking time normally being related to the longer times of the well done steaks, according to thickness, that is, ten to 15 minutes, cutlets being given seven to ten minutes.

Appliances available

Grills and salamanders available are:

The Benham under-fired gas grill: A speedy grill with ample accommodation.

Benham Salamanders: Made in three sizes (16-in., 24-in. and 36-in. width of grill). Heated by quick heating steel frets from above, these will accommodate eight, 12 or 18 average-size steaks or chops at a time.

Potterton catering cooker grill: Small accommodation of two steaks per grill, or four cutlets. Cooking time is halved due to bottom cooking plate being used.

R. & A. Main's 222 and 225 salamanders: The 222 salamander will grill 12 steaks at once within a cooking time approximately half those quoted due to the use of a grilling hearth. The 225 salamander, with grilling hearth, is a small grill with an accommodation of four to six steaks. The appliance, which can be built up in units, has a wide potential of output with minimum gas economy.

The Radiation Heating Grillmaster: This firm have two models of the 'Grillmaster' which is a fast salamander incorporating surface combustion burners and a form of bottom cooking plate. The larger model will accommodate ten to 12 steaks and the smaller one six steaks. For many years this firm have marketed a salamander, gas-heated, air- and power-generated, giving a powerful and fierce heat. It is in three sizes accommodating eight, 12 or 24 steaks on the grid. This salamander could well use a bottom cooking plate.

Smith & Wellstood—underfired grill: This firm have an under-fired grill with a similar accommodation to the Benham model. It is as yet in its infancy and a really good field test should prove it one way or the other.

Metropolitan Meters—Colwin Red Ray grill: This is a top- and side-heated salamander/grill that can take four to six steaks in the horizontal position and one to two in the vertical rack; a useful appliance in some industrial kitchens.

Still & Sons—Salamanders: This firm have two salamanders, one a heavy-duty restaurant model which has a griddle plate overhead of the salamander and which will grill eight to ten steaks at a time. The other model is a toaster and salamander, lighter in construction, which will take six to eight steaks.

Oliver Tom's underfired grill: This firm, who hitherto have not marketed a grill or salamander, will soon be launching a version of the under-fired grill. It is a specialist appliance.

Other makers of salamanders are the *Falkirk Iron Company, Carron, Crittall-Aquafont* and *Green's*, all producing appliances particularly suitable for grilling meats, toasting bread and 'finishing' cooked dishes.

The Benham composite range in the new kitchen. Illustrated are a deep fat fryer unit, a three-unit Solid-top range with salamander grill and bain marie. At the far end of the range is the gas-heated pressure steamer.

NEW STAFF KITCHEN INCORPORATES THE BEST IN GAS-FIRED EQUIPMENT

A NEW kitchen, situated on the top floor of the tall, modern Siemens Edison Swan building, on the Harlow Eastern Industrial Estate, Essex, serves the attractive staff dining room seating 120 persons, and the visitors dining room seating 12.

The kitchen was planned by Benham & Sons Ltd., in conjunction with the architect, and the equipment was ordered through the Eastern Gas Board.

Equipment, supplied and installed by Benham & Sons, is gas-heated and the servery includes an angular service counter, 19 ft. 3 in. long, incorporating hot closet with bain maries and food service containers, and a counter water boiler (Aquafont); also in the servery is a 10 ft. 8 in. stainless steel topped service counter for waitress service through the doors behind it.

Kitchen equipment includes a total of 23 ft. of stainless steel sinks and drainers. The Benham composite range is made up of one deep fat fryer unit, three-unit Solid-top range, with salamander grill and bain marie. At the far end of the range is the gas-heated pressure steamer.

The kitchen commenced operation in April this year, and can cater for 90 staff by cafeteria service, and 30 staff and 12 visitors by waitress service.

Furnace plant at the two factories of Babcock & Wilcox Ltd.

A NEW TECHNICAL REPORT ON THEIR GAS HEAT TREATMENT AND HOT WORKING EQUIPMENT

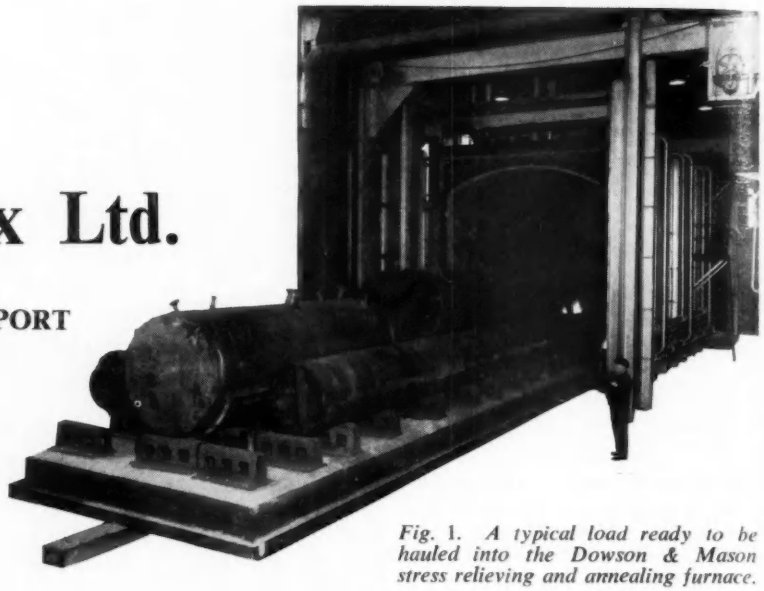

Fig. 1. A typical load ready to be hauled into the Dowson & Mason stress relieving and annealing furnace.

BABCOCK & WILCOX LTD., makers of steam boiler plant, a member of the English Electric—Babcock & Wilcox—Taylor Woodrow atomic power plant consortium, has works at Renfrew and Dumbarton, where furnace plant for hot working and accurate heat treatment is essential for almost every item of manufacture. In 1958 2 mill. therms of town gas were used in these factories.

This works, which covers an area of 165 acres and employs 8,000 persons, manufactures the pressure vessels, superheaters, heat exchangers, headers, manifolds, and pipes, etc., that make up power station plant, and, more recently, nuclear power plant. Much of the work is large and bulky; much also is of welded fabrication or construction which must be suitably heated to fit it for its arduous duty.

Gas plays an important part in the manufacturing process, and this article describes some of the furnace plant.

The drum shop

In the drum shop is a Dowson & Mason Ltd., stress relieving and annealing furnace, shown in Fig. 1, of the bogie-hearth type. Internal dimensions are: Width 14 ft., length 38 ft. 3 in., height 12 ft. 2 in. (top of bogie to spring of arch). The furnace is designed for stress relieving at 600-650°C., with occasional annealing at 900-950°C. It handles the large drums and cylinders that have been formed and welded, using steel plate of up to 5 in. thickness and more, and often having undergone further welding operations through the addition of pipe connections and other attachments.

Walls and arch

The 14-in. walls are of 9-in. insulating refractory with a backing of 4½ in. of diatomaceous insulation, the insulating refractory being threaded on individual short rods staggered at intervals and secured to the steel casing. The arch also is of insulating refractory and diatomaceous insulation, together with Vermiculite loose fill. The whole internal surface of the walls and roof is coated with a brick seal bonding mortar

The door consists of structural steel members provided with clamps and lined with light weight insulating refractories threaded on vertical steel rods in a similar manner to the construction of the side walls. The door traverses sideways on a single-beam overhead runway electrically operated from pendent chains. It is provided with lips at top and bottom which run in sand seals over the arch and at the end of the bogie. Additionally, asbestos pads are fitted so that when the door is clamped against the face of the opening there is a positive seal preventing gas leakage.

The bogie top is constructed with a number of shallow grooves in which 9-in. high heat resisting iron castings for supporting the load are placed. The brickwork of the top of the bogie is of Glenboig firebrick 4½ in. thick over a layer of 3-in. insulating refractory and a bottom layer of diatomaceous insulation. Heavy cast iron sand troughs are arranged round the front and two sides, with a moveable sand seal trough at the back to prevent air infiltration. The moveable trough is automatically operated by the bogie.

Electrically-driven haulage gear is provided for moving the bogie in and out of the furnace and a limit switch is incorporated to prevent over-run of the bogie, so that even if the operator is careless it cannot crash into the back wall. Furthermore, the controller is connected with a limit switch on the furnace door traversing gear which ensures that the door is in its fully open position before the bogie is moved into or out of the furnace.

Nozzle-mixing burners

The furnace has 60 burners, 30 on each side at hearth level, firing alternately, horizontally, and vertically, the flame being deflected upwards by a tile in front of the burner. The burners are of the nozzle-mixing type, using air at 5 in. w.g. and have a

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maximum rated capacity of 60 therms per hour. The waste gases pass through flues at hearth level which are joined together and connected to underground cross flues to meet the main flue.

For temperature control purposes the furnace is divided into three zones. In each zone there are the following fully floating temperature controlling and recording devices:

(i) An 8-ft. long control thermocouple projecting through the roof, raising and lowering gear being provided to lift it clear when the charge is moved. This is connected to an Electroflo potentiometric recording controller which actuates gas and air valves in that particular zone by means of a hydraulically operated regulator.

(ii) Three thermocouples, one through the roof and one at each side approximately 4 ft. above bogie level. These are connected to multipoint temperature recorders.

Automatic furnace pressure control is effected through the main flue regulator, and registered by the pressure recording controller.

The design figures and estimates given in Table I are based on heating the furnace and charge from cold. The relatively small requirements for annealing at the higher temperature did not justify the provision of larger burner equipment to reduce the time required for that treatment.

Table I

Weight of charge, ...	*tons*	50	50	100	100
Temperature, ...	*°C.*	620	940	620	940
Gas required (excluding soak), ..	*therms*	485	1080	800	1750
Time to reach holding temp., ..	*hours*	8·75	19·5	14·5	31·25
Heat input at holding temp., ..	*therms per hour*	22	45	22	45
Gas required (excluding soak), ..	*therms per ton*	9·5	21·6	8	17·5

Performance

The results of two tests are given in Table II. Details of the charge and the treatment specified are as follows:

Test No. 1

Charge: Three drums, total weight 70 tons.

(i) 20 ft. 6 in.×5 ft. i.d.× 5 in. thick.

(ii) 34 ft. 4in.×4 ft. 6 in. i.d. ×2 5/16—1¾ in. thick.

(iii) 15 ft. 9 in.×4 ft. i.d.× 4—1¼ in. thick.

The heating cycle was a primary stress relief at a temperature of 625°C., the stipulated holding period being not less than three hours.

Table II

		Test No. 1	Test No. 2
Weight of charge, ...	*tons*	70	91·1
Temperature, ...	*°C.*	625	600
Gas used (excluding soak), ...	*therms*	680	645
Time to reach holding temperature, ...	*hours*	11·25	10·8
Gas used (excluding soak), ...	*therms per ton*	9·7	7·1

Test No. 2

Charge: Three drums, total weight 91.1 tons.

(i) 28 ft. 6 in.× 4 ft. 6 in. i.d. ×4½ in. thick.

(ii) 14 ft.×5 ft. 6 in. i.d. 5¼ in. thick.

(iii) 15 ft. 2 in.× 5 ft. 6 in. i.d.×5¼ in. thick.

The heating cycle was a primary stress relief of high tensile steel drums at a temperature of 600°C., the stipulated holding period being not less than two hours.

Tube and manifold department

In the tube and manifold department is a Dowson & Mason furnace (shown in Fig. 2). It is of the bogie type, having an inside door width of 10 ft. 6 in. by 4 ft. high from the top of the piers on the bogie to the spring of the arch, and a length of 40 ft. 3 in. The bogie is 10 ft. 3 in. wide by 40 ft. long. This furnace was designed for normalising, annealing and stress relieving.

The load of manifolds shown in the photograph are ¾-1½ in. thick and range in size from 6-7½ in. square and 10-20 in. dia., with a length of up to 40 ft. and more. They are manufactured by hot extrusion, the ends being

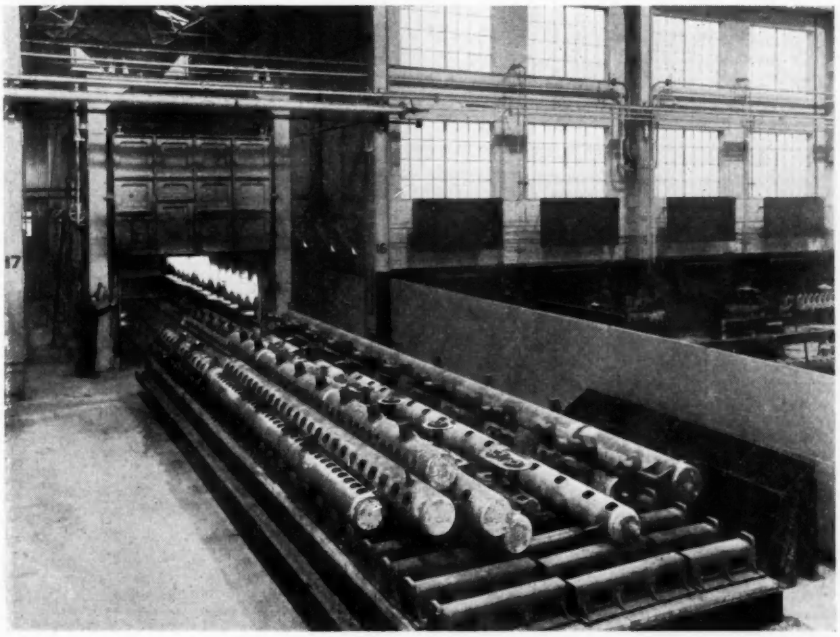

Fig. 2. The Dowson & Mason heat treatment furnace in the tube and manifold department.

Table III

Weight of charge,	*tons*	30	30
Temperature,	°C.	650	950
Gas required (excluding soak),	*therms*	327	870
Time to reach holding temperature,	*hours*	6	14
Maintenance heat input at temperature,	*therms per hour*	13	39

closed by hot swaging, and much machining and welding is finally performed. Stress relieving is therefore important; mild steel is stress relieved at 650°C., and alloy steels at temperatures up to 725°C. Superheater and economiser tube banks, which undergo bending and other hot working, are annealed or normalised, according to requirements, at temperatures between 920°C. and 950°C.

Lining faces

The walls and roof of the furnace are of light-weight insulating refractories 9 in. thick. To allow an adequate cooling rate, no diatomaceous insulation is used; the inside faces of the lining are coated with a refractory cement.

The door, made up of cast iron sections, is lined with insulating refractories held by mild steel rods. There is a removable portion with an opening about 2 ft. square to enable manifolds longer than 40 ft. to be treated. The door is counterbalanced, but operated by a hydraulic cylinder and interlocked with the bogie haulage mechanism so that the bogie cannot be moved until the door is open.

The top of the bogie is of 4½-in. firebrick built on 3-in. courses of insulating refractory and diatomaceous insulation. Heat resisting steel load supports are used, similar to the iron supports for the drum shop furnace. Electric haulage gear is fitted in a pit below floor level.

The furnace has 60 burners, 30 at hearth level on each side firing alternately horizontally and vertically with a maximum rated capacity of 64 therms per hour. Those firing horizontally are nozzle-mixing burners and those firing vertically are luminous flame burners, air being supplied at 8 in. w.g. The luminous flames are obtained by slow mixing of the air and gas streams and avoid the production of high heat intensity at the base of the side walls. This is important because of the necessity to obtain very close temperature uniformity over the whole of the furnace.

The waste gases are exhausted through a number of flues at bogie hearth level arranged along the side walls. These are connected to horizontal flues below the furnace, which in turn pass into the main flue and to a separate chimney built at one side of the furnace.

Controlling equipment

The furnace is divided into three zones each controlled by George Kent Ltd. fully floating pneumatic recording controlling equipment connected to thermocouples in the furnace roof. These instruments operate air-gas proportioning valves in each zone. In addition, thermocouples in the side walls are connected to a six-point recorder. Automatic furnace pressure control is effected through the pneumatically operated main flue damper, and a gas flow recorder is included in the instrument panel.

The furnace is designed for a load of the order of 30 tons, excluding the stool castings. The estimates given in Table III are based on heating the furnace and charge from cold.

The figures given in Table IV are taken at random from the daily records of normal operation in which, after each charge is heated, the furnace is cooled down almost to atmospheric temperature before a charge is inserted on the following day. Net figures are given for the weight of charge, but each includes, in addition, 4.9 tons of support castings.

Table IV

	Weight of charge, *tons*	Time to heat, *hr. min.*	Soaking time, *hr. min.*	Gas consumption, *therms*	Gas consumption, *therms per ton*
Operation at 650°C. with ½-hour soaking periods	8	2 45	30	175	21·9
	12	2 10	30	166	13·8
	30	3	30	218	7·3
	34	2	30	180	5·3
Operation at 650°C. with more than 1-hour soak	13·25	2 35	1 20	259	19·5
	16·45	3 15	1 15	225	13·7
	20·6	3 20	1 20	268	13·0
	23·1	3 15	2	298	12·9
Operation at 710°C. with ½-hour soak	6	2 40	30	196	32.6
	42	3 30	30	296	7·0

The pipe shop

In the pipe shop a stress relieving and annealing furnace is installed. Built by Dowson & Mason Ltd., this furnace is also of the bogie hearth type, and has the following internal dimensions: Width 10 ft. 6 in., length 22 ft., height 5 ft. (top of bogie to spring of arch).

The capacity of the shop includes pipes ranging from 4½ in. to 18 in. dia., and from ⅜ in. to 2 in. thick, all solid drawn tube. The furnace is used for the heat treatment of bends and flange and branch welds. Mild steel is stress relieved at 650°C., and alloy steels, after welding, at 725°C., or, after hot bending or forging, annealed or normalised, according to specification, at temperatures of 915°C-920°C.

The furnace has walls of 9-in. insulating refractory backed up with 4½-in. diatomaceous insulation, and the roof is of 9-in. insulating refractory and 3-in. diatomaceous insulation with Vermiculite loose fill. Heat resisting iron pier castings are used for supporting the load as on the furnaces previously described. There are 30 nozzle-mixing air-blast burners in the furnace, 15 on each side, half of them firing vertically and the other half firing horizontally between the stools on the bogie. The maximum rated capacity is 32 therms per hour.

The furnace is fitted with Geo. Kent Ltd. fully floating pneumatic recording controlling temperature equipment, operating proportioning combined gas and air valves, the furnace being divided into two zones. The controlling thermocouples are arranged in the arch and fitted with raising and lowering gear. Automatic furnace pressure control is effected through a pneumatically operated butterfly damper.

The furnace was designed for a load of 12 tons, excluding support castings, and the makers estimated that a full load would reach 920°C. in six hours with a gas consumption of 16 therms per ton.

In the steel foundry the furnace plant is used for the annealing of iron and steel castings at temperatures of 680°C. and 950°C. respectively.

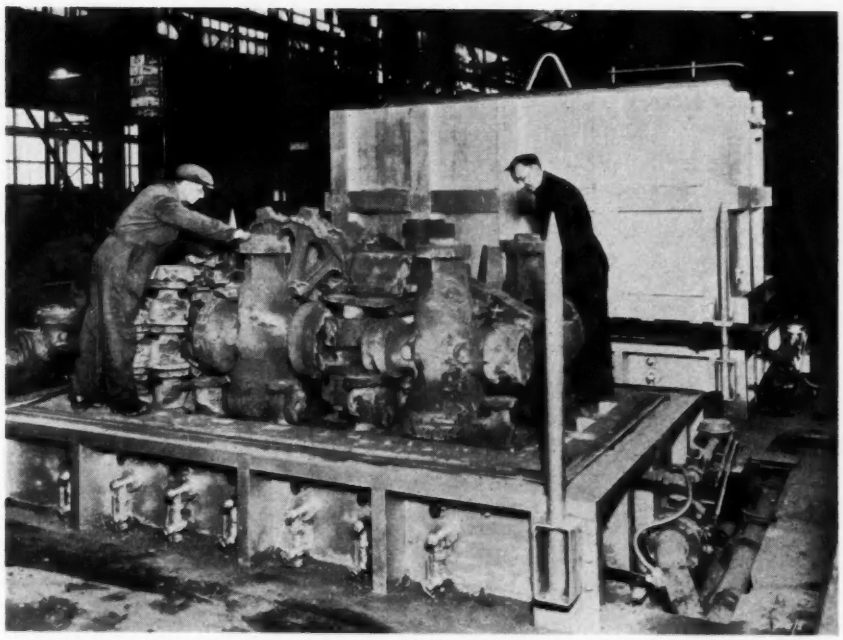

Fig. 3. Portable cover annealing furnaces in the steel foundry.

The installation by Dowson & Mason Ltd. illustrated in Fig. 3 consists of two bases, each 4 ft. 9 in. wide by 9 ft. 9 in. long, and a removable hood lined with light-weight insulating refractory. The height from the hearth to the roof of the hood is 5 ft. 3 in. With one hood and two bases, a load being stacked on one base while another is being heated on the second base covered by the removable hood, almost continuous operation can be obtained.

Protection from damage

The hearths are constructed of fire brick tiles covered by flat cast plates which protect the firebrick from damage which would otherwise result from the loading of a great variety of castings, some of which have sharp edges. Each base will take a load of 8 tons of castings and is equipped with 14 burners arranged along the two long sides, the burners projecting highly luminous flames vertically upwards. The waste gases pass off at each end through ports in the hearth, and through thimble type recuperators of calorised mild steel, preheating the air for combustion before passing to the chimney.

Electroflo two-position temperature control equipment is fitted, the control thermocouple being placed in the roof of the cover. The control instrument is connected to two valve regulators which operate the gas and air valves of each base. Other thermocouples are connected to a six-point temperature recorder.

The makers' estimate of performance taking a typical load of 4 tons as a basis is given in Table V.

The header factory produces the tubes which pass to the tube and manifold department for further working, and which were mentioned earlier when describing the work of that section. The circular tubes, of 10 to 20 in. diameter and ¾ in. to 1½ in. thickness, are closed by a swaging process after the tube end has been heated to 1,100°C.-1,200°C.

Tube end heating

Two identical furnaces of Babcock & Wilcox design are in use for the tube end heating. In each the working chamber is a horizontal cylinder, 3 ft. diameter by 2 ft. long, closed at one end. The tube is inserted at the other end through a circular opening, the diameter of which can be varied by the use of refractory rings appropriate to the size of tube. Dense refractories are employed in the construction, and the furnace operates with a wall temperature in the order of 1,400°C.

Tangentially-firing burners

The furnace has two tangentially-firing burners spaced 180° apart on a circle midway between the two ends of the chamber. The burners are of the nozzle-mixing type with a centre air jet from which the air issues with a swirling motion into a short combustion tunnel. Air is supplied at 28 in. w.g. and the maximum gas rate of each furnace is 20 therms per hour.

Superheater tubes are bent cold as far as possible, but for final closure, the bend must be heated. For this purpose there are a number of Superheater tube bending furnaces of the type shown in Fig. 4. The furnaces, by Dowson & Mason Ltd., have a dense refractory lining backed by insulation, and the working chamber is shaped to direct the flow of gases from the two automatic proportioning burners over the work and out of the work slot, which measures 15 in. by 4½ in. Combustion air is supplied at 28 in. w.g. and the maximum gas rate is 4½ therms per hour, though this is regulated according to the rate of working, the furnace operating at a temperature in the order of 1,300°C.

Superheater tubes of 2½ in. o.d. with a wall thickness of $\frac{7}{16}$ in. are heated for bending in 3 to 4 min. Many

Table V

		4 tons cast iron	4 tons steel
Charge,			
Temperature,	°C.	680	950
Gas required (excluding soak)	*therms*	42·5	85
Time to reach holding temperature	*hours*	3	5
Maintenance heat input at temperature,	*therms per hour*	3·2	7·7
Total gas required, including ½ to 1-hour soak,	*therms per ton*	11·5	22·2

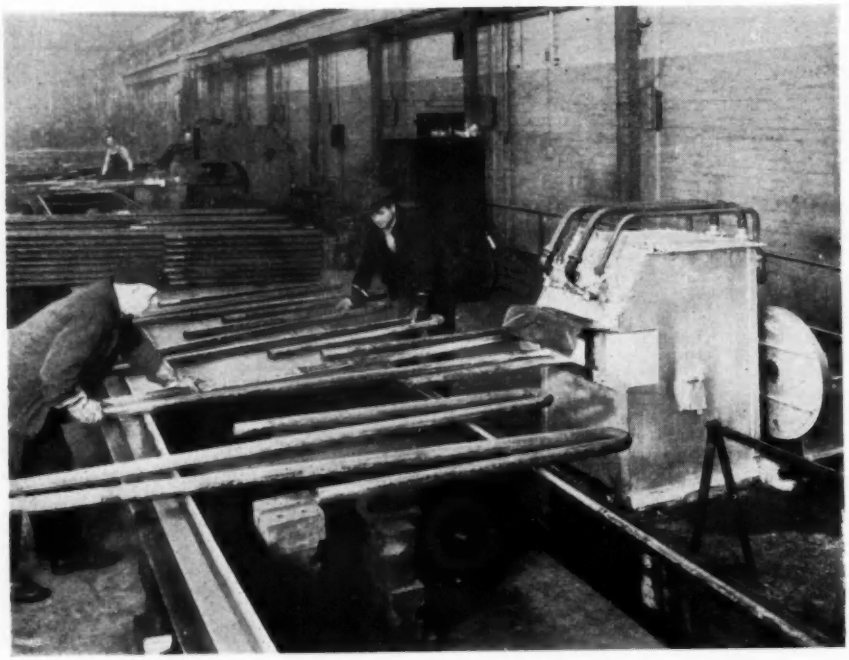

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Fig. 4. One of the superheater tube bending furnaces.

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other boiler and superheater tubes can be heated, and for light gauges the heating times are not more than 1¼ to 1½ min.

Dumbarton works

The Dumbarton works is a tube works, manufacturing the high quality material that the Renfrew works transforms into boiler tubes and superheater nests. Here the sequence of furnace plant is as follows:—(i) Billet heating furnace; (ii) reducing mill furnace; and (iii) tube annealing furnace.

The first of these, the billet heating furnace, is illustrated in Fig. 5. This shows the 6½-in. dia. billets, 2 ft. to 4 ft. long, rolling into the preheat zone of a Dowson & Mason billet heating furnace and Fig. 6 shows the automatic discharge of a billet to the mill at a temperature of 1,316°C. The hot billet passes first to the rotary elongator, where it is drawn over a piercing plug, and then to the pilger mill.

The general arrangement of the billet heating furnace is shown in Fig. 7. The effective length inside the furnace is 68 ft. and the width 6 ft. 7 in., so that billets up to 5 ft. 6 in. can be handled. It is divided into two zones, one heating with a slope of 1 in 10, and one soaking with a slope of 1 in 20. The length of the soaking zone is 18 ft. The hot gases pass out of the furnace chamber at the charging end into a flue beneath the preheat section and thence to the recuperator which preheats the air for

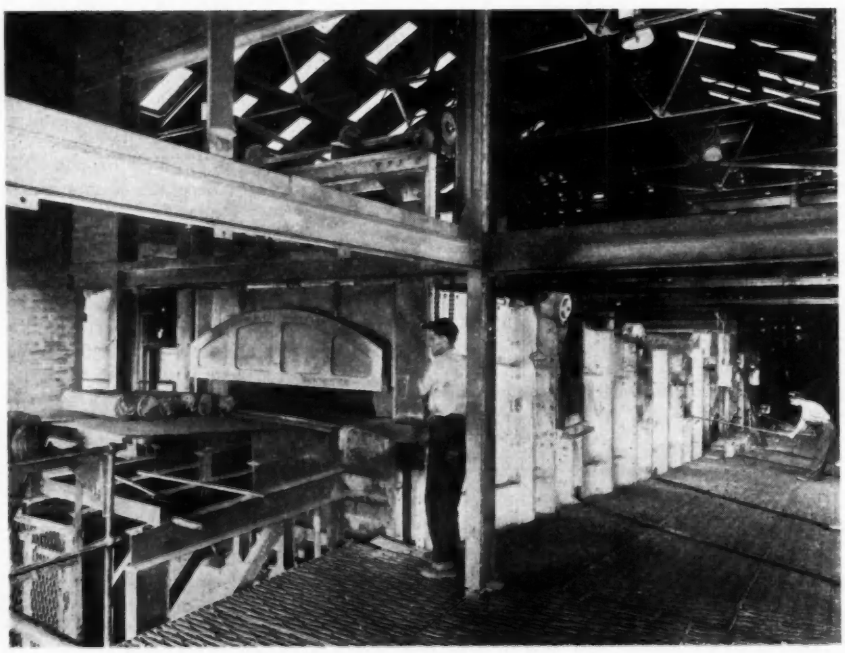

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Fig. 5. Billets rolling into the preheat zone of a Dowson & Mason billet heating furnace.

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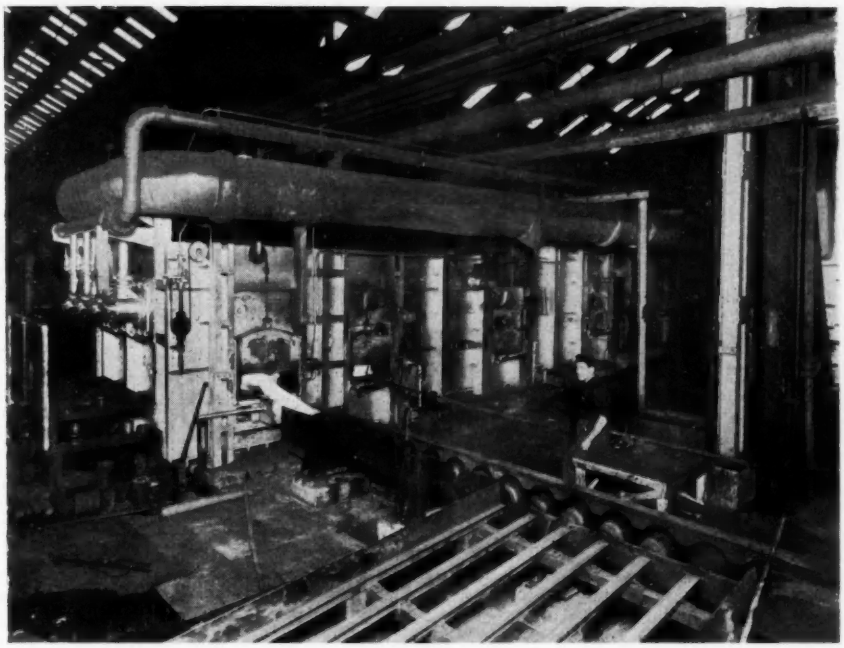


Fig. 6. The automatic discharge of a billet to the mill.

combustion. From the outlet of the recuperator, the waste gases pass to the chimney.

The side walls of the heating and soaking zones are constructed of 9 in. of Stein 50 alumina refractory backed up with 4½ in. of Stein 'Nettle' quality firebrick and with 4½-in. vermiculite insulating brick. In the preheating zone the side walls are of 9-in. 'Thistle' firebrick backed with 9 in. of diatomaceous insulation. The roofs of the heating and soaking zones are of Stein sillimanite covered with a 3-in. layer of alumina insulating refractory, and in the preheating zone the arch is of 9-in. 'Nettle' firebrick covered with 4½-in. diatomaceous insulation. The hearth of the preheating section is of Stein 73 alumina refractory, but in the heating and soaking zone Stein magnesite is used.

Total gas rate

There are three burners of equal capacity in each of the two zones, firing under the arch in each case. They are of the selective flame type, designed to allow a long or short flame to be produced at will without altering the proportion of gas or air. The total gas rate is 144 therms per hour with preheated air supplied in the burners at 10 in. w.g.

The Newton Chambers needle type recuperator is arranged in an insulated refractory lined structure above floor level. The makers estimated that with a full output of 6 tons per hour, the hot gas temperature at the inlet would be 600°C. and that this would be reduced to 400°C. at the outlet, preheating the air for combustion

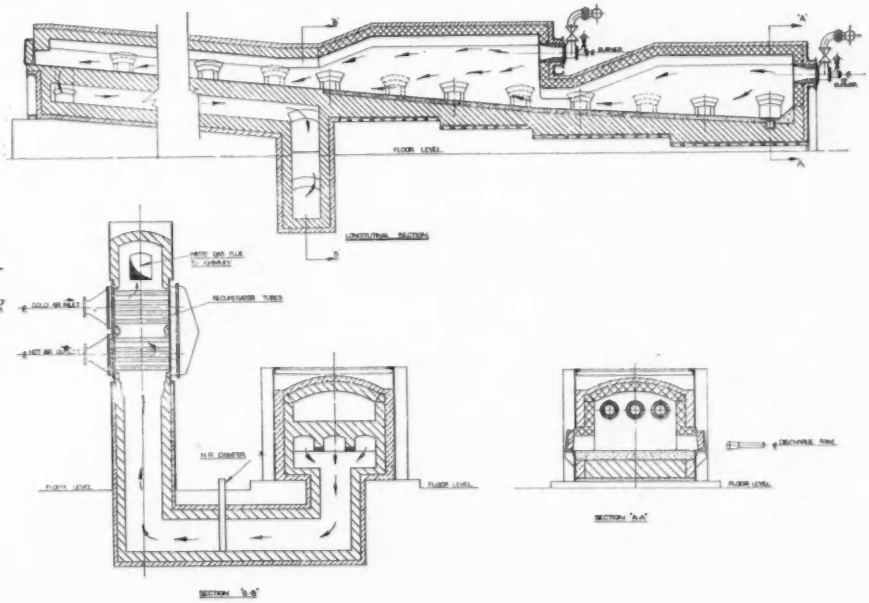


Fig. 7. General arrangement of the billet heating furnace.

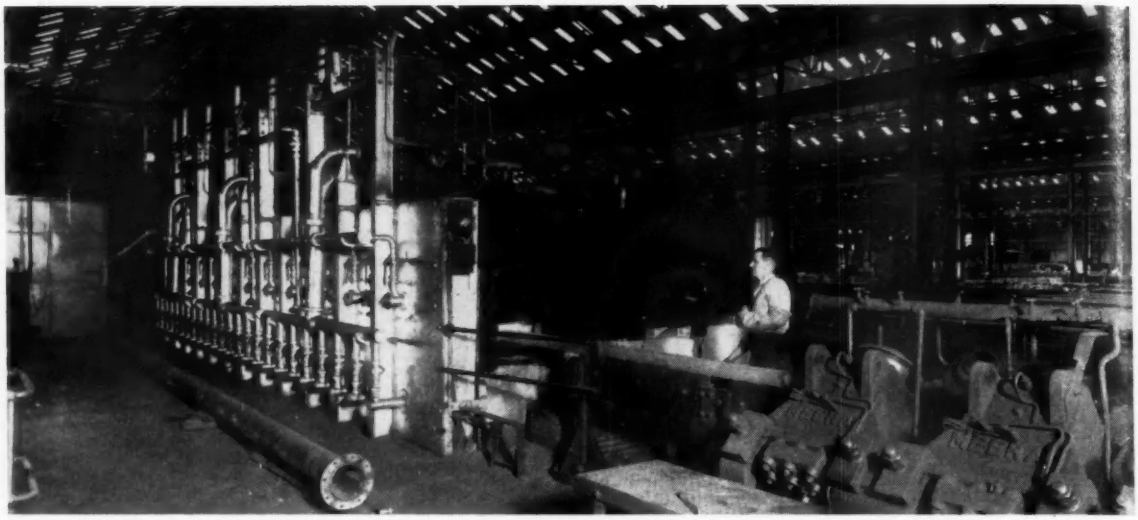


Fig. 8. A Dowson & Mason roll-down recuperative tube reheating furnace, showing a tube being discharged.

to 310°C. The air is delivered to the burners in pipes insulated with 3 in. of Stillite.

At the discharge end are two hydraulically operated doors, one on each side, 1 ft. 9 in. wide. Between the doors and set into the brickwork at hearth level there is a cast steel trough, internally water-cooled, from which the billet is discharged. An electrically driven pusher unit situated on one side of the furnace operates through the doors to discharge the heated billet from the furnace.

The furnace is equipped with instruments by Electroflo Meters Ltd., providing full automatic temperature, pressure, and combustion control. The heating and soaking zones each have a temperature controller set and air/gas proportioning system. The potentiometric fully floating recording control instruments operate the air valves of each zone by hydraulic regulators. Venturi meters in the gas and air supplies to each zone are connected to gas/air ratio regulators actuating the gas valves to give the right combustion conditions. The furnace pressure controller-recorder actuates the main damper. A three-point recorder measures the temperature of the hot gases entering the recuperator, the gas leaving the recuperator, and the preheated air flowing to the burners. An orifice plate, ring balance meter, integrator and recorder are used to measure the total gas flow. A radiation pyrometer is fixed in position sighting through the furnace wall on to the billet in the trough to ensure that the temperature is correct at discharge, the dial indicator being sited so that it can be seen by the mill operator discharging the billet.

The furnace was designed for an output of 6 tons per hour of steel billets, 6 in. dia., 4 ft. 6 in. long (31 billets per hour) at a temperature of 1,316°C. The maximum number of billets in the furnace at one time is 135, and the planned heating time 4 hours 20 min. It was estimated that this output would be achieved with a gas consumption of 118 therms per hour, i.e., 19.7 therms per ton.

The billets being handled by the furnace are $6\frac{1}{2}$ in. dia., with length in the range 2 ft. to 4 ft., limiting the output to a maximum of 5 tons per hour. The actual output depends on producton requirements. Results obtained during four consecutive weeks are given in Table VI. The furnace was shut down for the week-end

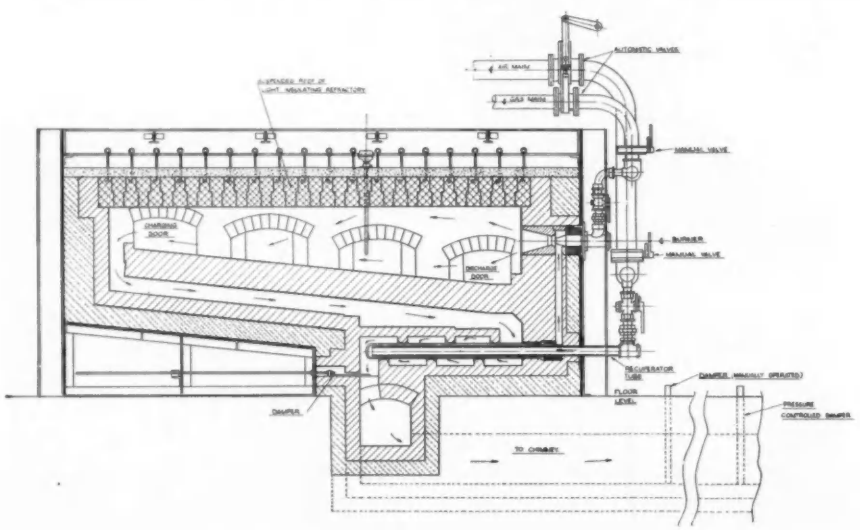


Fig. 9. Reducing mill furnace.

Table VI

	Average Output, *tons per hr.*	Gas used, including heating-up, *therms per ton*
1st week ..	4·53	21·6
2nd week ..	3·17	27·1
3rd week ..	4·72	22·6
4th week ..	3·03	27·6

periods, and the gas required to regain the operating temperature is included.

Reducing mill furnace

Tubes from the pilger mill are reheated in a Dowson & Mason roll-down recuperative tube reheating furnace which reheats them to about 950°C. for discharge to the reducing mill where the tube size is reduced. Fig. 8 shows a tube being discharged into the reducing mill.

A diagram showing the general arrangement is given in Fig. 9. The furnace, designed to handle tubes up to 33 ft. in length, has a width of 35 ft. and a length of 10 ft. 9 in. The tubes enter endwise through a small door at the upper end of the slope, and are discharged through another similar door at the bottom. The tubes roll down the slope inside the furnace, unless they are bowed, in which case it is necessary for the furnace operators to do a certain amount of barring through the side doors.

Arrangement of burners

There are 24 burners arranged in three groups in one side wall to fire over the tubes. The hot gases then flow through a number of ports at the charge end and are carried under the hearth before coming into contact with the recuperator elements, preheating the air for combustion. Finally the waste gases are collected into three main flues, each of which corresponds with a zone of the temperature control equipment, and carried to the 40-ft. chimney.

The furnace has a firebrick lining backed with diatomaceous insulation, except the roof which is constructed of lightweight insulating refractory. The furnace has been heavily insulated to help in the attainment of uniform temperature and high thermal efficiency.

The burners consist of a heat resisting steel gas burner nozzle behind a refractory venturi. The position of the nozzle can be adjusted to give the most favourable operating conditions. With preheated air supplied at 3 in. w.g. the maximum gas rate is 87 therms per hour. There is a thimble tube metallic recuperator element for each burner, consisting of an outer tube of heat resisting steel and an inner tube of calorised mild steel, so arranged that the air for combustion when preheated immediately passes within the furnace brickwork to the nozzle of the burner.

A tube is charged into the furnace from a charging trough fitted with electrically driven rollers, giving the tube sufficient speed to land inside the furnace clear of the wall. An electrically driven pusher discharges the tube from the furnace where it is gripped in the reducing mill which pulls the tube clear. Charging and discharging doors are hydraulically operated and linked with the charging and discharging gear.

For the purposes of temperature control the furnace is divided into three zones, each fitted wtih Electroflo fully floating control equipment which includes a hydraulically operated regulator connected to proportional opening gas and air valves. A three-point recording pyrometer is connected to thermocouples at various points within the furnace and each zone is provided with orfice plates and flow indicators for both gas and air.

Electroflo equipment is used also for furnace pressure control, a hydraulic regulator operating the main damper.

In Table VII are given typical figures of the output and size of tube upon which the furnace was designed. The table includes the makers' estimates of heat requirements based on tubes entering the furnace at an average temperature of 500°C. and leaving at 950°C.

Table VII

Output, *tons per hour*	Tube o.d., *in.*	Tube Wall, *in.*	Tube Length, *ft.*	Tube Weight, *lb. per ft.*	Tube Number per hr.	Gas consumption *therms per hour*	Gas consumption *therms per ton*
8·5	4	0·374	28·5	15	45	81	9·5
7·4	3·5	0·374	33	13	40	73	9·9
5	4	0·169	26	7	60	56	11·3
3·8	2·24	0·151	18	3·7	135	47	12·4

The furnace is handling tubes of dimensions in the following ranges: Maximum length 34 ft., minimum 8 ft.; maximum dia. 4 in., minimum 2 in.; maximum gauge ½ in. thick, minimum 10 S.W.G.

Results obtained during four consecutive weeks are given in Table VIII. The furnace was shut down for the weekend periods and the gas required to regain the operating temperature is included.

In comparing these figures with the estimates, it should be noted that the tubes were rarely charged at 500°C., and after stacking awaiting charging were more often quite cool.

Table VIII

	Average output, *tons per hr.*	Gas used, including heating-up, *therms per ton*
1st week ..	6·12	12·5
2nd week ..	4·45	14·5
3rd week ..	5·48	13·7
4th week ..	5·41	14·4

(To be concluded)

POTATO CRISP MANUFACTURE

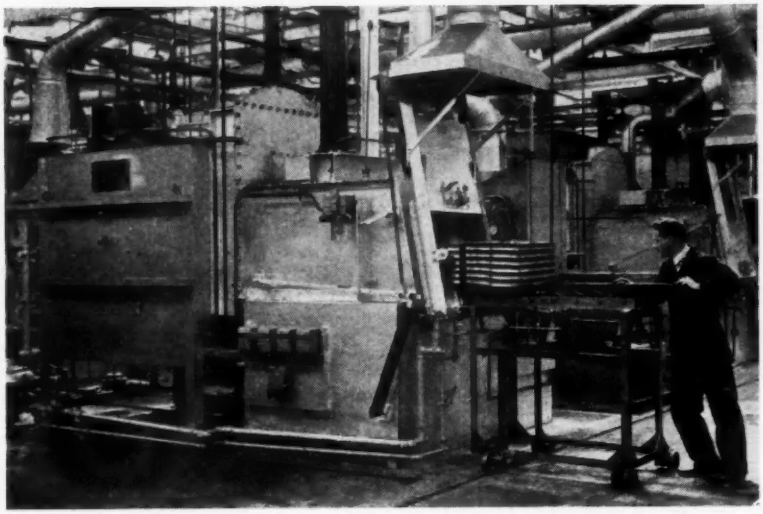
From p. 11

has long been customary in the trade to pack them in strong rectangular tins, which are returnable. The tins themselves are relatively expensive to procure while there is always the problem of cleaning the returned tins before they can be re-filled and despatched again. Crimpy Crisps Ltd. are now beginning to pack packets of crisps in polythene bags for despatch in expendable cartons.

In the meantime, however, many thousands of tins are still in use and gas is used in the tin washing and drying plant sited in a separate building. This washing machine is manufactured by Robert Kellie & Son Ltd.

All the gas used at Crimpy Crisps Ltd., together with the services associated with the supply, comes from the Southern Gas Board.

THE VERSATILE "ALCASE" FURNACE



Processes—

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4. Dry Cyaniding or Carbonitriding.
5. Carbon Restoration.
6. Homogeneous Carburizing.
7. Clean Annealing.

The two "Allcase" furnaces

illustrated are at the works of a leading motor manufacturer, and are used for carburizing and carbonitriding steering and other parts requiring various case compositions and depths. The hearth area of each furnace is 3′ 0″ X 2′ 0″ with 1′ 6″ permissible depth of charge, and is designed to accommodate gross charge weights varying from 900 lbs. at 750°C. to 500 lbs. at 950°C.

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